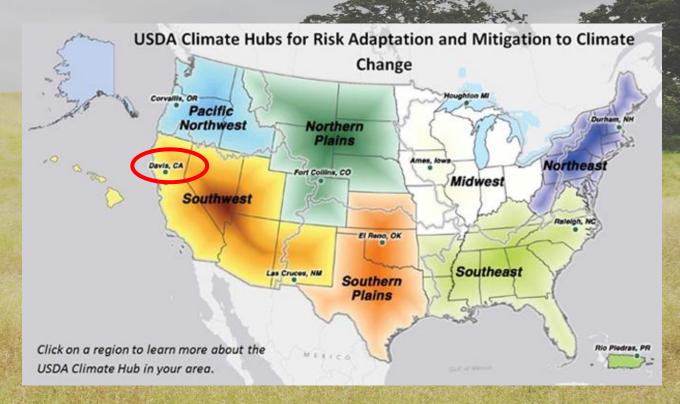
USDA California Climate Hub

Actionable Climate Information for California's Farmers, Ranchers, and Foresters





Jennifer Balachowski, PhD, Climate Hub Fellow

The challenge and approach

Research

Climatic Change DOI 10.1007/s10584-007-9367-8

Accumulated winter chill is decreasing in the fruit growing regions of California

Dennis Baldocchi · Simon Wong

Received: 2 August 2006 / Accepted: 5 October 2007 © Springer Science + Business Media B.V. 2007

Abstract We examined tren of central California and its warming is in motion in Ca across the fruit and nut grow accumulated winter chill (be climate datasets. The Calif contains hourly climate dat chill degree-hours. But, its National Weather Service C many sites. But its datasets temperatures. To assess lon algorithm that converted int accumulated hours of winter calculations of chill hour climate datasets, we found degree hours is diminishin Observed trends in winter ci applied our analytical algori winter chill, for the period b 500 chill hours per winter. T have deleterious economic a the end of the 21st Century.

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PLOS one

Climatic Changes Lead to Declining Winter Chill for Fruit and Nut Trees in California during 1950–2099

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California perennial crops in a changing climate

David B. Lobell - Christopher B. Field

Climatic Change (2011) 109 (Suppl 1):S317-S333 DOI 10.1007/s10584-011-0303-6

Received: 9 March 2010 / Accepted: 26 September 2011 / Published online: 24 November 2011 © Springer Science+Business Media B.V. 2011

Abstract Perennial crops are among the most valuable of California's diverse agricultural products. They are also potentially the most influenced by information on future climate, since individual plants are commonly grown for more than 30 years. This study evaluated the impacts of future climate changes on the 20 most valuable perennial crops in California, using a combination of statistical crop models and downscaled climate model projections. County records on crop harvests and weather from 1980 to 2005 were used to evaluate the influence of weather on yields, with a series of cross-validation and sensitivity tests used to evaluate the robustness of perceived effects. In the end, only four models appear to have a clear weather response based on historical data, with another four presenting significant but less robust relationships. Projecting impacts of climate trends to 2050 using historical relationships reveals that cherries are the only crop unambiguously threatened by warming with no crops clearly benefiting from warming. Another robust result is that almond yields will be harmed by winter warming, although this effect may be counteracted by beneficial warming in spring and summer. Overall, the study has advanced understanding of climate impacts on California agriculture and has highlighted the importance of measuring and tracking uncertainties due to the difficulty of uncovering crop-climate relationships.

1 Introduction

Agriculture is an important component of California's economy, landscape, and culture, and is among the human activities most vulnerable to impending climate changes. Two particularly unique and relevant features of agricultures of agricultures of agricultures of agricultures of agricultures of crops grown, with California the leading U.S. producer of over 80 crops, and (2) the substantial fraction of agricultural value (roughly one-chiffer

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es of a location's suitability for the production of many two elected future changes in winter chill in California, quantifie

temperature records, where thill was modeled for two paniors (sevenge conditions during 2041-2000 and 2080-209 missions somation, for the CSRO-MSQ, HadCAM and MRIOcestly temperature record were produced, unity a stochasti (climate statistic, "fair winter chill", the 10% quantile of the site than the area of calle winter chill for many the and 50-100% by late century.

rojected climatic conditions by the middle to end of the 2 ps curemity grown in California, with the Chilling Hours Mo tree cop industry in California will likely need to devel domancy-breaking chemicals) to cope with these project gobbe.

Jining Whiter Chill for Fruit and Nut Trees in Galfornia during 1950-2099. PLoS

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female flowering, such as walnuts and pistachios, insufficie thilling can reduce pollination, also leading to reduced crop yel-[10]. If winter chill decline occurs due to climate change production contrains are likely to exceed those spicially reporte because many trees might not even some cise to faiffling the

their yield poemial, rendering many orchard operations unconmicial [4,11].

Apricultural size initial hard developent informational models in all Apricultural size initial hard developent methods and models inpartitions with the correspond to acadeller colletting as a specific location. However, a geometri undersameling of available winner shall its likely to reflect concilions of the part such than those expected for a source finance, lines excluded only an extension of their interest of the control of the control of the control of Mill in memorals in lines of insulance collect changes. Without such conditionation, many orchands only in review independent of the control of the contr

July 2009 | Volume 4 | Issue 7 | e6166



Bridging Mission of the USDA Climate Hubs



Producers



Drought Fact Sheets



California Drought Fact Sheet Series

outhwest Regional Climate Hub and California Sub Hub

Crop Fact Sheet series

Excepted from The Southwest Regional Climate Hub and California Subsidiary Hub Assessment of Climate Change Vulnerability and Adaptation and Mitigation Strategies (July 2015)

Crop Fact Sheets

This report describes the potential vulnerability of specialty crops, field crops, forests, and animal agriculture to climatedriven environmental changes. In the report vulnerability is defined as a function of exposure to climate change effects. sensitivity to these effects, and adaptive capacity. The exposure of specific sectors of the agricultural and forestry industries varies across the region because the Southwest is climatically and topographically diverse. The purpose of this analysis is to describe regional vulnerabilities to climate change and adaptive actions that can be employed to maintain productivity of working lands in the coming decades.

The report can be accessed here: http://swclimatehub.info/files/Southwest-California-Vulnerability-Assessment.pdf

Strawberries

Fragaria × ananassa (Rosaceae)



Strawberries are California's most valuable annual crop: more than \$2B annually, accounting for about 90% of U.S. production [1]. This may seem surprising when strawberries are only grown on 39,000 acres - almost exclusively in the coastal areas of central and Southern California (Figure 1). The apparent mismatch between value and acreage is because strawberries have the highest value per acre of any of California's major specialty crops (by nearly a factor of ten).

Strawberries are expensive and difficult to grow and harvest. They are highly vulnerable to soil-borne fungal diseases such as Fusarium wilt and Verticillium wilt, and so (despite being a perennial plant) they are replanted every year to allow the soil to be thoroughly furnigated. Even organic strawberry growers usually obtain their seedlings from non-organic nurseries. Fragile and perishable, strawberries must be hand-picked and transported in refrigerated trucks.

All strawberries in California are irrigated, almost exclusively using drip irrigation underneath plastic mulching; this reduces disease by keeping moisture away from the foliage [3]. Irrigation varies from about 10 to 40 inches per year, with an average of 21 inches [4]. Strawberries are highly sensitive to salinity, which means that they may require water in excess of their evaporative demand for the sake of leaching salts from the soil (Table 1).

Strawberries prefer a cool coastal climate, which is one main reason that California's strawberry fields are much more productive than those elsewhere in the country [3]. Unusually warm temperatures can not only shorten the growing cycle, they can promote pests and diseases, such as mites, fruit rot, com earworms, and caterpillars.

Temperature: Lobell et al. [5] used historical climate and crop data to model the effect of temperature on strawberry yields in California. They concluded that strawberry production was favored by cool, wet Novembers and moderately warm, dry springs, in accordance with what growers had reported qualitatively. The current level of uncertainty in downscaled climate projections for California makes it difficult to say whether these precise conditions will become more or less likely in the future.

In a follow-up study, Lobell and Field [6] predicted that climate change would decrease yields of California strawberries by about 10% by 2050, with impacts somewhat greater in the southern part of the state. However, Deschenes and Kolstad [7] predict that strawberry yields would decline by 43% by 2070-2099. Further statistical modeling could help increase the accuracy and specificity of these predictions. Nevertheless, it seems clear that warmer temperatures will very likely harm statewide strawberry production in coming decades.



Flaure 1. Acres of strawberries grown in CA in 2012 (39,000 acres), [2]

Drought and rangeland sustainability

California rangelands: definition and importance

Rangeland is defined in a number of ways along a variety of factors, including ecosystem type, dominant vegetation, and utility for livestock grazing. The Sustainable Rangelands Roundtable, for instance, defines rangelands as "areas dominated by self-propagating vegetation comprised predominantly of grasses, grass-likes, forbs, shrubs, and dispersed trees" 1, while the Forest and Rangeland Resources Assessment and Policy Act of 1977 defines them as land that is, among other things, "suitable for grazing or browsing of domestic livestock for at least a portion of the year" 2. While not all definitions include explicit mention of grazing, rangelands commonly provide millions of acres of critical forage-edible grasses. forbs, and shrubs-to support California's cattle, sheep, and goat industries.

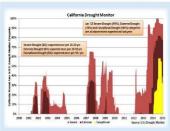


Cattle grazing in California's Wildcat Canyon Regional Park.

How does drought affect rangelands?

Forage production in California rangelands is strongly received only 21% of the average rainfall expected from on temperate, rainy weather in the fall and winter, while acre to merely 475 pounds per acre in March 2015 7. growth in central California is more dependent on this weather during the spring 4.

Rangelands in the Sierra foothills, for instance, have



dependent on the magnitude and timing of precipitation³. January to March of 2015 ⁶. As a result, forage production Summer forage in northern California is highly dependent per acre has fallen from an average of 700 pounds per

Climate stressors also impact the livestock industries that utilize rangelands. Livestock tend to graze near sources The intensity of the current drought threatens significant of water, and as excess heat stresses the animals and impacts to rangelands and the multi-billion dollar the drought makes stock ponds dry up and disappear, livestock industries of California that depend on it 5, the animals will concentrate their grazing around the few water sources left. If ranchers do not reduce stocking rates, this can cause overgrazing in these locations—a problem typically followed by ecosystem damage like soil erosion, reduced root length in vegetation, and susceptibility to non-native species invasion 8,9. In addition, the concentration of salts in drying forage makes livestock thirstier upon eating it, and can even be toxic at high nitrate levels 10. All the while, stock ponds are drying up and getting saltier themselves. Rising water temperatures in ponds or troughs can themselves dramatically increase livestock water needs and contribute significantly the unhealthy concentration of salts and the growth of toxic blue-green algae in water sources11. Altogether, livestock water demand will be increasingly unmet by California's drying, warming rangelands, as both the quantity and quality of forage and water are decreasing with the drought.

Vulnerability Assessment

Southwest Regional Climate Hub and California Subsidiary Hub Assessment of Climate Change Vulnerability and Adaptation and Mitigation Strategies



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August 2015

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Thank you – Contact The USDA Regional Climate Hub

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